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SOME WOOD STAINING FUNGI FROM VARIOUS LOCALITIES IN THE UNITED STATES.¹

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(Condensed from the original notes and from descriptions of the cultural characters in the report of the Missouri Botanical Garden.*)

The following species of fungi are described from artificial cultures grown under similar conditions, on similar agar media, and in most cases compared with measurements made from natural growths on wood or other substances.

Ceratostomella in all the species studied has at first a hyaline conidial stage of short duration which soon changes in color and develops dark colored, beaked perithecia, with hyaline ascospores borne in fugacious asci.

Graphium in artificial cultures has two quite distinct conidial stages; the first form of conidia is borne on simple, hyaline, erect hyphae, and disappears later, as the stalks or stromatal outgrowths bearing the heads with the second form are developed. The conidia of the first form, on account of their temporary nature, are called secondary conidia, and those borne in the mucilaginous heads primary conidia, because they are considered the most important conidial stage.

1. *CERATOSTOMELLA PILIFERA* (Fr.) Wint., Kryptogamenfl. 2:252, *Sphaeria pilifera* Fr. Syst. Myc. 2:472, *Sphaeria rostrata* Schum. Enum Fl. Saell. p 128, *Cerostoma piliferum* Fuckl. Symb. p. 128. Emended, Hedgcock, Mo. Bot. Gard. Rept. 17:64-67, pl. 4, fig. 5-7. Colonies white in conidial stage, changing to gray or brown, with the formation of perithecia; filaments, 3μ to 4μ , hyaline to brown or black; conidia, 8μ to 12μ by 2μ to 4μ , hyaline elliptical to cylindrical, borne terminally in whorls of short, branching chains from upright, hyaline hyphae; perithecia, usually superficial, carbonaceous, globose to pyriform, smooth or sparsely hirsute below, 50μ to 200μ in diameter, with a long, slender beak, 600μ to $1,050\mu$ by 20μ , terminated by a ring of hyaline bristles, 20μ by 2μ average; asci, fugacious, hyaline, pyriform to ovate, 10μ to 15μ by 8μ to 10μ ; ascospores, 8, biseriate, hyaline, elliptical, often curved slightly, 5.5μ to 2.5μ average, exuded in a mucous mass.

On the wood of *Pinus ponderosa* Laws, staining it a blue-black color. Collector, H. von Schrenk, Sheridan, Wyoming, January, 1903.

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* Hedgcock, G. G. Studies upon some chromogenic fungi which discolor wood. Mo. Bot. Gar. Rep. 17: 59-114. Pl. 4-12; 1906, issued as a separate, Sep. 27, 1906.

2. *CERATOSTOMELLA SCHRENKIANA* Hedgcock. Mo. Bot. Gard. Rept. 17:67-69, pl. 4, fig. 1-4. Colonies with conidia white, changing to gray with the formation of perithecia; filaments hyaline to brown, 3μ to 7μ ; conidia, hyaline, often guttulate when old, elliptical to cylindrical, 3μ to 7μ by 1μ to 2μ , borne terminally on upright hyphae in short, branching chains; perithecia, globose, 120μ to 200μ , black, carbonaceous, often slightly hirsute below, or with numerous globular outgrowths, with a beak 8 mm. to 1.2 mm. by 10μ to 25μ , surmounted at maturity with a ring of short, hyaline, spreading bristles, 10μ to 15μ by 2μ ; asci, fugacious, ovate to pyriform; ascospores, hyaline, elliptical, often slightly curved, 2.5μ to 4μ by 1μ to 1.5μ .

On the wood of *Pinus echinata* Mill., staining it a blue-black color. Collector H. von Schrenk, Grandin, Mo., July, 1905.

3. *CERATOSTOMELLA ECHINELLA* E. & E. N. A. Pyr. 195 (1892). Emended, Hedgcock, Mo. Bot. Gard. Rept. 17:69-71, pl. 6, fig. 1. Colonies with conidia, white, changing to brown with perithecia; hyphae, hyaline to brown, 4μ to 7μ in diam.; conidia obovate to elliptical, 4μ to 6.5μ by 2μ to 3.5μ , borne in whorls of short, branching chains, from upright, hyaline hyphae; perithecia, globose or slightly flattened, 50μ to 100μ , glandular-pubescent, membranaceo-carbonaceous, with a long, slightly curved, striate beak, 1 mm. to 1.7 mm. by 15μ to 25μ , terminated with a ring of hyaline bristles, averaging 15μ to 25μ by 1.5μ to 2μ ; glandular hairs on perithecium 10μ to 32μ in length, tapering from 1.5μ to 2.1μ in diam., with glandular, globose tip, 2μ to 3μ in diam.; asci, elliptical to clavate; ascospores, hyaline, cylindrical or slightly curved, biseriate, 4μ to 6μ by 1.2μ to 1.6μ , cream colored in mass.

On wood of *Fagus atropunicea* (Marsh.) Sud., staining it blue or brown. Collector H. von Schrenk, Kirbyville, Texas, July, 1906.

4. *CERATOSTOMELLA CAPILLIFERA* Hedgcock. Mo. Bot. Gard. Rept. 17:71, 72, pl. 6, fig. 2, 3. Colonies with conidia white, changing to gray or brown, with perithecia; filaments, hyaline to brown 2μ to 6μ in diam.; conidia, hyaline, elliptical to cylindrical, 4μ to 8μ by 1.5μ to 2μ , borne in short branching chains, terminal from upright hyphae; perithecia, globose, often flattened, black, carbonaceous, slightly hirsute below, 90μ to 200μ , with a long, slender beak, 1.5 mm. by 25μ , terminated in a ring of long slender, hyaline filaments, 80μ by 1μ ; asci, fugacious, obovate; ascospores, 8, elliptic to reniform, 4.5μ to 1.5μ average.

On the wood of *Liquidambar styraciflua* L., staining it black. Collector H. von Schrenk, Marianna, Arkansas, July, 1905.

5. *CERATOSTOMELLA PLURIANNULATA* Hedgcock. Mo. Bot. Gard. Rept. 17:72-74, pl. 5, fig. 2. Colonies with conidia white,

changing to black with perithecia; filaments hyaline to brown; conidia, hyaline elliptical or obovate, 5μ to 8μ by 2μ to 3μ , borne terminally on erect hyphae in short, branching chains finally falling together in clusters; perithecia globose 90μ to 120μ in diam. black, carbonaceous, slightly hirsute below, with a smooth beak, .9 mm. to 2.1 mm. by 10μ to 30μ , adorned by one or more rings of short, spiny bristles, one of which is terminal; asci, obovate; ascospores, hyaline, reniform to elliptical, 4μ to 5μ by 1.5μ to 1.7μ .

On the wood of *Quercus rubra* L., discoloring it. Collector P. Spaulding, southern Indiana, August, 1905.

6. CERATOSTOMELLA MINOR Hedgcock. Mo. Bot. Gard. Rept. 17:74-76, pl. 5, fig. 6, 7. Colonies with conidia, white, changing to black with perithecia; filaments, hyaline to dark brown, 1.5μ to 4μ in diam., often coarsely rugose in wood cells; conidia, hyaline, 4μ to 5.5μ by 1.8μ to 2μ average, oval to elliptical, borne terminally on upright hyphae in short, branching chains; perithecia solitary, numerous, spherical, black, carbonaceous, rugose, sparsely hirsute at the base, 40μ to 70μ in diam.; with a beak 120μ to 160μ by 6μ to 12μ surmounted at maturity by a ring of thick hyaline bristles; asci, fugacious, round to oval or pyriform; ascospores, 8, hyaline, 3.1μ to 4.2μ by $.9\mu$ to 1.9μ , usually in four.

On the wood of *Pinus arizonica* Eng., staining it blueish-black. Collector J. L. Webb, Flagstaff, Arizona, July, 1904.

7. CERATOSTOMELLA EXIGUA Hedgcock. Mo. Bot. Gard. Rept. 17:76-78, pl. 6, fig. 4-7. Colonies with conidia white, changing to intense black with perithecia; filaments, hyaline to dark brown, often finely rugose in wood, 2μ to 6μ in diameter, conidia 3.5μ to 4.5μ by 1.6μ to 2.2μ , oval to elliptical, borne terminally on upright hyphae in short, branching chains falling together in rounded masses; perithecia, often gregarious, usually superficial, sparsely hirsute at base, black, carbonaceous, rugose, globose, 60μ to 80μ in diameter with a beak 150μ to 200μ by 8μ to 18μ , terminating in a ring of slender hyaline bristles; asci, fugacious, hyaline, pyriform to elliptical; ascospores, 8, often in fours, hyaline, elliptical to reniform, 2.1μ to 2.8μ by 0.8μ to 1.1μ .

On wood of *Pinus virginiana* Mill., staining it dark blue or black. Collector A. D. Hopkins, Kanawha, W. Va., Sept., 1904.

8. CERATOSTOMELLA MONILIFORMIS Hedgcock. Mo. Bot. Gard. Rept. 17:78-80, pl. 5, fig. 3-5. Colonies with conidia, gray, changing to black, with the formation of perithecia; filaments, hyaline, 2μ to 8μ in diam., often granular, later brown or black; conidia, hyaline, 6μ to 8μ by 1.8μ to 2.2μ , elliptical to cylindrical, moniliform, collecting in masses, borne on simple or branching erect hyphae; perithecia brown or black, often membranaceous,

globose, 90μ to 180μ in diam., covered sparsely with conical spines, 12μ to 20μ in length by 1μ at the apex, and 6μ at the base; the beak is brown or black, .6 mm. to 1 mm. by 10μ to 30μ , striate, surmounted by thick, hyaline bristles, 12μ to 18μ by 2μ ; asci, oval, 20μ by 10μ , fugacious; ascospores, 8, hyaline gray in mass, oval to elliptical often flattened on one side, 4μ to 5μ by 3μ to 4μ .

On the wood of *Liquidambar styraciflua* L., staining it brown. Collector H. von Schrenk, Kirbyville, Texas, July, 1906.

9. *GRAPHIUM EUMORPHUM* Sacc., Syll. Fung. 4:611, *Sporocybe eumorpha* Sacc. Fung. It. n. 942. (1881). Emended, Boulanger, Rev. Gén. de Bot. 7:97-102, 166-170. (1895)., pl. 2-5. Hedgcock, Mo. Bot. Gard. Rept. 17:87-88, pl. 7, fig. 1-5. Colonies white or gray, changing to light, or even dark green in the stromata; hyphae, 1μ to 2μ in diameter, hyaline to light green; secondary conidia, 7.8μ by 3.4μ , hyaline, often greenish yellow, borne singly or in whorled clusters on upright hyphae; primary conidia, 7.7μ by 3.4μ , hyaline, tinged with green, borne terminally on alternately branched hyphae in mucoid, stromatal heads; heads, spherical with mucous sheath, oval without, 30μ to 100μ in diameter, gray to iridescent green; stalks, simple or gregarious, dark to light green, or even yellow green, 300μ to 500μ in length, 10μ to 40μ in diameter; *Anthina*-like forms present.

On wood of *Rubus strigosus* L., staining it a dirty color. Missouri Botanical Garden, June, 1905. G. G. Hedgcock, collector.

10. *GRAPHIUM ATROVIRENS* Hedgcock, Mo. Bot. Gard. Rept. 17:88-90, pl. 8, fig. 1-3. Colonies white, changing to dark green in the stromata; filaments, 3μ to 4μ , hyaline, changing to gray, green or olive; secondary conidia, 4μ to 5.5μ by 1.6μ to 2μ , hyaline, obovate to elliptical, guttulate when old, borne on simple hyphae in short, branching moniliform chains, finally adhering in masses; primary conidia, 3.5μ to 4.5μ by 1.4μ to 2μ , hyaline, obovate to elliptical, borne in flattened, oval, white to gray heads, which with mucous sheath measure 40μ to 600μ in diameter; stromatal stalks, usually solitary, slender hyaline to dark green, 1.5mm to 3mm. by 8μ to 80μ , base often slightly enlarged; tall, sterile, *Anthina*-like stalks often form.

On the wood of *Liquidambar styraciflua* L., Marianna, Ark., staining it black. Collected by H. von Schrenk, July, 1905.

11. *GRAPHIUM SMARAGDINUM* (A. & S.) Sacc. Syll. Fung. 4:618. Emended, Hedgcock, Mo. Bot. Garden Rep. 17:91, 92, pl. 9, fig. 8-10. Colonies white to gray-green or olive in stromata; filaments hyaline to dark green, 2μ to 4μ in diameter; secondary conidia 3.6μ by 1.8μ , hyaline, elliptical, borne continuously from the ends of simple or branched upright hyphae, collecting in mucoid masses; primary conidia, 3.2μ to 4.2μ by 1.7μ

to 2μ , hyaline, elliptical, borne from the ends of alternately branched hyphae in the stromatal heads; heads with mucous sheath, spherical, 40μ to 600μ , without sheath, fungiform, often with the edges recurved; stalks simple and gregarious, 1mm. to 2mm. by 8μ to 90μ , often enlarged in the center, sterile *Anthina*-like outgrowths of the stroma often present.

On the wood of *Liquidambar styraciflua* L., Marianna, Ark., staining it black. Collected by H. von Schrenk, July, 1905.

12. *GRAPHIUM RIGIDUM* (Pers.) Sacc. Syll. Fung. 4:610, *Stilbum rigidum* Pers. Uster Annal. 1:32. Emended, Hedgcock, Mo. Bot. Gard. Rept. 17:92-94, pl. 7, fig. 6-10. Colonies white, changing to brown or black in stromata; hyphae, 2μ to 4μ in diam., hyaline to gray or olive; secondary conidia, 3μ to 4.5μ by 1μ to 1.5μ , hyaline, elliptical, borne continuously and terminally from erect simple or branched hyphae, falling at once into mucoid masses; primary conidia, 3.5μ to 1.5μ , elliptical to cylindrical, hyaline, borne on alternately branched hyphae in stromatal heads; heads spherical, with mucous sheath, 20μ to 500μ in diam., white to a dingy yellow; stalks, 1 mm. to 2mm. by 10μ to 40μ , gray to brown or black, solitary or gregarious, rigid, not expanded.

On the sapwood of *Quercus rubra* L., staining the wood brown. Collector, P. Spaulding, Indiana, Sept., 1905.

13. *GRAPHIUM AUREUM* Hedgcock, Mo. Bot. Gard. Rept. 17:94-96, pl. 9, fig. 5-7. Colonies white, changing to pale yellow or light brown in the stromata; filaments, 2μ to 3μ , hyaline to light brown; secondary conidia, 4μ to 8μ by 1μ to 2μ , obovate to clavate, hyaline, guttulate when old, borne in short, branching moniliform chains or in clusters of simple conidia; primary conidia, 4μ to 5μ by 1μ to 2μ , hyaline, obovate, borne terminally on filaments of the flattened, oval head; head with mucous white to yellow, spherical, 15μ to 240μ in diameter; stromatal stalks, simple or gregarious, 50μ to 750μ by 10μ to 90μ ; sterile, *Anthina*-like stalks are often present.

On sapwood of *Pinus strobus* L., Ashland, Wisconsin, staining it a dirty color. Collected by H. von Schrenk, April, 1905.

14. *GRAPHIUM ALBUM* (Corda) Sacc. Syll. Fung. 4:618, *Ceratopodium album* Corda Ic. Fung. 1:20. Emended, Hedgcock, Mo. Bot. Gard. Rept. 17:96-97, pl. 9, fig. 1-4. Colonies white, changing to light yellow or orange in the stromata; filaments hyaline to yellow or light brown, 2μ to 3μ in diameter; secondary conidia, 4μ to 6μ by 1μ to 2μ , hyaline, obovate to clavate, guttulate when old, borne in short, branching moniliform chains terminally from erect hyphae; primary conidia 3μ to 5μ by 1μ to 1.5μ , hyaline, obovate, borne terminally on the filaments of the stromatal heads; heads white to creamy yellow, or even a light brown when old and dry, spherical with mucous, 20μ to 600μ in diameter, without mucous a flattened oval to fungi-

form, stalks .3mm. to 2mm. by 30μ to 300μ , varying from yellow to dark brown at the base; *Anthina*-like, stromatal forms present.

Found on sapwood of *Fagus atropunicea* (Marsh.) Sud., staining it brown. Collected by P. Spaulding, Arkansas, Sept., 1905.

15. *GRAPHIUM AMBROSIIIGERUM* Hedgcock, Mo. Bot. Gard. Rept. 17:85-86, pl. 8, fig. 4-7. Colonies white, changing to brown in stromata; filaments 1.5μ to 2.5μ , hyaline to brown; secondary conidia 3.7μ by 1.3μ , hyaline, oval to elliptical, borne in whorled clusters of simple conidia on upright hyphae; primary conidia 5μ by 3μ , borne on filaments in stromatal heads; heads oval without mucous sheath, white to dark brown, with sheath, spherical, 30μ to 300μ ; stalks black or brown, 500μ to 900μ by 10μ to 40μ , simple or gregarious.

On the sapwood of *Pinus arizonica* Eng. in beetle holes staining it black. Collected by J. L. Webb, Flagstaff, Arizona, July, 1904.

16. *FUSARIUM ROSEUM* Link Sp. Pl. Fungi 2:105. *Fusidium roseum* Link Obs. 2:31. Colonies white, changing to pink, red, or lilac; microconidia one- to two-celled, hyaline, oval to elliptical, 8μ to 14μ by 3μ to 6μ , often uninucleate; macroconidia, 19μ to 30μ by 3.5μ to 6μ , straight or slightly curved, fusiform, two- to four-celled; chlamydospores, spherical, or slightly flattened, granular, yellow to dark brown, 10μ to 14μ in diameter; dark green or brown sclerotia present in cultures on boiled potato; staining pine sapwood pink to lilac.

On the sapwood of *Pinus strobus* L., Ashland, Wisconsin. Collected by H. von Schrenk, April, 1905.

Saccardo gives several varieties of *Fusarium roseum*, most of which differ greatly in the size of the microconidia. Those of our fungus are smaller than most of the measurements given by Saccardo, making it a little doubtful if the species is *F. roseum*.

17. *HORMODENDRON CLADOSPORIOIDES* (Fres.) Sacc. Mich. 2:148. *Penicillium cladosporioides* Fres. Beitr. 3:22. Colonies, gray or greenish yellow, changing to velvety brown or black; filaments, gray to olive, 2μ to 8μ ; sporophores, 100μ to 400μ by 3μ to 4μ , with branches one to three-septate, measuring 6μ to 15μ by 3μ to 5μ ; conidia, 3μ to 7μ by 2μ to 4μ , usually unicellular, oval, olive, or brown, in short, branched chains of two to six, staining sapwood black.

On the sapwood of pine, elm, gum and oak, Missouri and Arkansas. Collected by H. von Schrenk and Geo. G. Hedgcock.

18. *HORMODENDRON GRISEUM* Hedgcock, Mo. Bot. Gard. Rept. 17:100, 101, pl. 10, fig. 2. Colonies gray, changing to dingy black, furry; filaments, granular, hyaline to gray or black, 3μ to 10μ in diameter; sporophores, 20μ to 800μ by

3μ to 4μ , with branches one to three-septate, measuring 6μ to 14μ by 3μ to 4μ ; conidia 3μ to 6μ by 2μ to 4μ , usually unicellular, pointed oval, gray to sooty, borne in short, branched chains of 2 to 10; staining sapwood black.

On the wood of *Liquidambar styraciflua* L., from various points in Arkansas. Collected by H. von Schrenk, July, 1905.

19. *HORMISCIMUM GELATINOSUM* Hedgcock, Mo. Bot. Gard. Rept. 17:101-103, pl. 11, fig. 4-8. Colonies yeast-like at first, creamy, changing to brown or black, finally becoming fimbriate or toruloid; filaments, often toruloid or beaded, cylindrical cells 5μ to 10μ in diameter, and spherical cells 2μ to 8μ ; conidia borne both on prostrate and upright hyphae, dimorphus, the form on prostrate hyphae is of two types, the one hyaline, elliptical, thin-walled, fugacious, 8μ to 12μ by 3μ to 5μ , the other brown, elliptical, thick-walled, 10μ to 14μ ; the form on short, upright hyphae, globose dark olive, 7μ to 12μ in diameter, borne in chains which do not break apart readily; staining sapwood black.

On the sapwood of pine, elm and gum, from various points in Arkansas and Missouri, collected by H. von Schrenk and Geo. G. Hedgcock, 1905.

20. *PENICILLIUM AUREUM* Corda, Prachtfl. 18:38, Sacc. Syll. Fung. 4:82. Emended, Hedgcock, Mo. Bot. Gard. Rept. 17:105-107, pl. 11, fig. 1-3. Colonies, gray, or sometimes blue green, changing to lemon yellow, or orange red; mycelium, dimorphus, filaments, 3μ to 8μ in diameter, cells sometimes swollen or beaded; sterile hyphae, curled and distorted, lemon yellow on acid media, orange red on alkaline, bearing exuded granules of a soluble pigment which is yellow with acid, and red with alkali; fertile hyphae, erect, 100μ to 500μ by 3μ , often with two sets of whorled branches, each branch averaging 12μ by 2μ ; conidia blue green, pointed oval 3μ to 4μ by 1.5μ to 2μ , borne in simple chains of 40 to 80, containing a soluble blue green pigment, not changed in color by acids or alkalis; staining pine sapwood yellow or red. *Coremium* forms often present on rich agar media.

On the sapwood of *Pinus strobus* L., Ashland, Wisconsin, collected by H. von Schrenk, April, 1905.